In the Specification
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brake;

[0013] Figure 8 is an enlarged schematic illustration showing a relationship between a rotor and inboard and outboard friction members of the present invention during a brake application; and

[0014] Figure 9 is a sectional view of a second embodiment of carriers for the first and second friction members for use in a disc brake according to the present invention.

## DETAILED DESCRIPTION

[0015] In this description a same number may be used for a feature in describing a same component when used in a different locations or it necessary ' may be added to the original number.

[0016] Figures 1, 2, 3 and 5 illustrate a disc brake 10 made according to the present invention for use in a brake system of a vehicle. The disc brake 10 includes an anchor 12 that is fixed to the housing 14 and a caliper 16 that is mounted to slide on the anchor 12. Anchor 12 includes a first rail 18 that has two spaced apart support members 32 and 34 and a second rail 20 that has two spaced apart support members 36 and 38. The anchor 12 is attached to the housing such that the first rail 18 and the second rail are aligned in a manner to be perpendicular to a rotor 26. The first 18 and second 20 rails retain, guide and support first 22 and second 24[-] friction ~~member~~ members that are located on opposite sides of the rotor 26. To effect a brake application, pressurized fluid is supplied through port 125 to a chamber 127 in caliper 16. The pressurized fluid in chamber ~~27~~ 127 acts on a piston 28 to move a pad 23 on the second friction member 24 into engagement with rotor 26 and acts on caliper 16 to move a pad 21 on the first friction member 22 into engagement with the rotor 26. When the pads 21 and 23 on the first and second friction members 22 and 24 engages the radial surfaces on the rotor 26, a brake force develops that is carried into the first 18 and 20 rails to oppose the rotation of rotor 26 and thereby effect a corresponding brake application. This engagement of the first friction member 22 with the first rail 18 and the second friction member 24 with the second 20 rail hold the first 22 and second 24 friction members in a parallel relationship with rotor 26 during the brake application such that a resulting brake force is directly communicated into the anchor 12 without the introduction of any lateral forces that may cause judder.

shown in ~~figures3~~ Figures 3 and 5 and is shaped to include a first end 78 with a first projection 80 thereon that is defined by a hook that is complimentary to rectangular slot 48 in the second support member 38 of the second rail 20 and a second end 82 with a second projection 80' thereon that is defined by a hook that is complimentary with a rectangular slot 48' in the second support member 34 in the first rail 18. Respectively locating projection 80 in rectangular slot 48' and projection 80' in rectangular slot ~~41'~~ 48' aligns the friction pad 23 in a plane that is parallel with radial surface 25 on rotor 26. A portion of slippers or guides 72,72' respectively extend into rectangular slots 48,48' from slots 40,40' and are located between projections 80',80 and the anchor 12. The slippers or guides 72,72' each have an additional leg 71,71' that acts on the carrier 64 to urge the projections 80,80' into engagement with bearing surfaces 54',54 in the rails 18 and 20 to prevent noise caused by rattling of the components.

[0020] For some applications, it may be easier to manufacture a disc brake wherein both the inboard and outboard carriers are identical such as the common backing plate or carrier 122 illustrated in Figure 9 for use in a disc brake 110. The carrier 122 for both a first and second friction member 120 would have a same shape and function in a similar manner as described above with respect to the dis-similar carriers 62 and 64 for the friction members 22 and 24. In more detail, in disc brake 110, the rectangular slot 140 in the first rail 118 and rectangular slot 140' in the second rail 118' of anchor 112 have an identical shape and the linear width "w" for the bearing surface between a first surface 150 and a second surface 152 on projection 141 and between a first surface 150' and a second surface 152' on projection 141' of anchor 112 are also identical. The backing plate or carrier 122 for the friction member 120 has an arcuate shape with a first end 124 and a second end 126. The first end 124 has a projection 128 that is defined by a hook or constraining shape that is complimentary with a projection 141 adjacent rectangular slot 140 of the first rail 118 and a second end 126 has a projection 130 that is defined by a hook or constraining shape that is complimentary with a projection 141' adjacent rectangular slot 140' for the second rail 118' of anchor 112. The backing place or carrier 122 is defined by a first arcuate length ~~l1~~ $l^1$ between a radial center "c" and a first face 142 on the first end 124 and a second arcuate length ~~l2~~ $l^2$ between the radial center "c" and a second face 144 on the second end 126 which are the same while a distance ~~"d1"~~ "$d^1$"

between the first face 142 and a first face 154 on projection 128 and a distance ~~"d2"~~ "$d^2$" between the second face 144 and a second face 148 on projection 130 are different, with "$d_2$" being larger that "$d_1$". The distances "$d_1$" and "$d_2$" are selected such that with the carrier 122 centered between the first and second projections 141,141', a clearance distance of "x" exits between faces 142 and 144 on carrier 122 and face 152 on projection 141 and face 152' on projection 141' with the carrier 122 centered between the first rail 118 and the second rail 118'. Since the width "w" for the bearing surfaces on projections 141,141' are the same, a smaller clearance distance "x-1" exist between face 150 on projection 141 of rail 118 and face 124 on projection (hook) 128 on the first end 124 and a larger clearance "x+1" exists between face 150' on projection 141' and a face 148 on projection 130 on the second end 126. As with the carriers 62 and 64 for disk brake 10, when projections 128 and 130 of the friction members 200 are respectively located in rails 118 and 118', the friction members 122,122' are located in planes that are parallel with radial surface 25 and 27 on rotor 26. Slippers or guides would be provided to cover slots 140,140' and projections 141,141' ~~to~~ and provide a smooth surface on which the ends 124 and 126 move with respect to rotor 26. In addition, hold down springs 176,176' ~~acts~~ act on the carriers 122,122' to urge the projections 128, 130 into engagement with bearing surfaces 143,143' on rails 118 and 118' to prevent noise caused by rattling of the components.

[0021] The rotor 26 has a first radial surface 25 and a second radial surface 27 that are initially defined by parallel planes but after a period of time because of wear changes in the thickness of the rotor may develop. The changes in thickness create a plurality of high (h,h') and low (l,l') spots with respect to an initial flat surface of the rotor. The high (h,h') and low (l,l') spots on the surfaces may create a serpentine shape in the rotor 26 and as a result engagement with the first 22 and second 24 friction members may produce judding that is carried back to the brake pedal.

## Mode of Operation of the Disc Brake

[0022] In a vehicle equipt with a disc brake 10, when an operator desires to effect a brake application, pressurized fluid is communicated to chamber 127 that acts on piston 28 to move a pad 23 on the second friction member 24 into engagement with rotor 26 and acts on caliper 16 to move a pad 21 on the first friction member 24 into engagement with

the rotor 26 to develop a braking force. When pad 21 on the first friction member 22 engages radial surface 27 on rotor 26, backing plate or carrier 62 is rotated and rectangular projection 70 of the first end 66 is moved into engagement with abutment surface 42 on the first rail 18, see Figures 4 and 8, and thereafter approximately one half of a resulting braking force is carried in to the anchor 12 through this point of engagement. The first friction member 22 may hereinafter be referred to as being pushed into engagement with the anchor 12. It should be understood at this time and during the brake application rectangular projection 70' on the second end 68 is not restrained with respect to abutment surface 42' but may pivot with respect to this engagement point 15. Similarly, when pad 23 on the second friction member 24 engages the radial surface 25 on the rotor 26, backing plate 64 is rotated and the hook defined by the first projection 80 on the first end 78 is brought into engagement with constraining surface 52 on the support member 38 of the second rail 20, see Figure 6, and thereafter the other one half of the braking force is carried into the anchor 12 at this engagement point 13. The second friction member 24 may hereinafter be referred as being pulled into engagement with the anchor 12. It should be understood at this time and during the remainder of the brake application the hook defined by the second projection 80' on the second end 82 is not restrained with respect to constraining surface 52' but may pivot with respect to this engagement point.

[0023] As long as the radial surfaces 25 and 27 on rotor 26 are smooth friction pad 21 on the first friction member 22 and friction pad 23 on the second friction member 24 respectively uniformly engage radial surface 25 and 27 to develop braking forces that are carried into the first 18 and 20 rails to oppose the rotation of rotor 26 and thereby effect a corresponding brake application. This engagement of the first friction member 22 with the first rail 18 and the second friction member 24 with the second 20 rail hold the first 22 and second 24 friction members in a parallel relationship with rotor 26 during a brake application such that a resulting brake forces F1 and F2 are directly communicated into the anchor 12 without the introduction of any lateral forces.

[0024] Unfortunately, after a period of time, rotor 26 may wear in a non-uniform manner such that high (h,h') and low (l,l') spots are located on the radial surface 25 and 27, see Figure 3, and in an extreme situation, the thickness may ~~appear~~ approach a

serpentine shape.

[0025] A ~~In prior art~~ disc brake 200 in the prior art is illustrated in Figure 7 wherein a rotor 216 has worn in a manner such than high 212,212' and low 214,214' spots are present the non-uniform radial surfaces present, a problem occurs when the high spots 212,21' pass between the point of engagement of the carriers of the first and second friction members and the abutment surfaces on a rail. ~~In Figure 7,~~ The disc brake has ~~is illustrated for~~ a carrier whereby braking forces are communicated through engagement points 220,220' for a first friction member 202 and a second friction member 204 ~~are carried~~ into an a same rail 205 of anchor 206. Whenever a high spot 212,212' on the rotor 26 passes between the engagement points 220,220', the friction members 202,204 must move radially with respect to the rail 205 or axial strain or forces L1 and L2 are introduced into the anchor 206 at the engagement points 220,220'. The high spots 212,212' on rotor 216 on ~~move~~ moving toward the engagement points 220,220' and introduce lateral forces ~~L1~~ $L_1$ and ~~L2~~ $L_2$ that must first overcome the arcuate braking forces ~~F1~~ $F_1$ and ~~F2~~ $F_2$ that are being transmitted into the rail 205 before any lateral movement occurs and as a result considerable stain may be introduced into the carriers 202 and 204. The stain produced during a brake application is referred as judder and in addition to noise may in an extreme situation produce feed back that is felt by an operator as surging. The disc brake 200 as illustrated in Figure 7 is pusher but the same situation would exist for a puller in that the braking forces for both a first carrier and a second carrier are transmitted into a same rail in an anchor and the high spots would exert an force in moving past the point of engagement.

[0026] The structure of disc brake 10 essentially eliminates the introduction of judder as the free end 68 on the first friction member 22 (the pusher) and the free end 82 on the second friction member 24 (the puller) ~~pivot~~ pivots when engaged by the high spots 212,212' such that lateral stress or force is not introduced into the anchor 12 at the engagement points 13,15. As illustrated in Figure 8, when a rotor 26 is rotating in the direction of arrow A~~, when~~ and a high spot 212 engages the friction pad 21 on the first friction member 22 adjacent the second rail 20 ~~and causes~~ the free end 68 of the carrier 62 ~~to~~ may pivot outwardly about the engagement point 15 of ~~end~~ the first rectangular projection 70 and support member 32 of rail 18. As high spot 212 rotates toward the first rail 18, the high spot 212 now acts on the friction pad 23 on the second friction member 24 to pivot carrier 64 about the hook

defined by projection 80 and constraining surface 52 of the first end 78 while allowing ~~free-end~~ second rectangular projection 70' on the second end 82 to pivot and move in rail 34. Thus, the introduction of lateral forces ~~L,L'~~ (L,L') into an anchor 12 by a rotor 26 with high spots 212,212' thereon is essentially eliminated through the sequential pivoting of the first 62 and second 64 carriers for the first 22 and second 24 friction members.

[0027] The second embodiment for the invention for a disc brake 110 as illustrated in Figure 9 having identical carriers 120 would function in a similar manner as follows. It is assumed that the rotor 26 is rotating in the direction of arrow A and on receipt of pressurized hydraulic fluid the piston would act on carrier 122' of the inboard friction member 120' while the caliper would act on the carrier 122 of the outboard friction member 120 to respectively urge pads into engagement with rotor 26. On engagement with rotor face 25, the outboard friction member 120 is rotated in the direction of arrow A toward the first rail 118 such that face 142 on the first end 124 is moved distance x and into engagement with face 152 on projection 141 while face 148 on end 130 never contacts face 150' as the distance x+1 is greater that distance x and as a result the outboard friction member 120 acts as pusher such that projection 130 is not constrained by the second rail 118'. At the same time the inboard friction member 120' is rotated toward the first rail 118 such that face 154 on the first end 124 engages face 150 on projection 141 while face ~~148~~ 144 on projection 130 of the second end 126 never contacts face ~~150'~~ 152 on projection 141' as the distance x-1 is less that the distance x and as a result the inboard friction member 120' acts as a puller as the projection 130 is not constrained by the first rail 118. When a high spot 212,212' on the rotor 26 engages the pads, the carrier 122 for the outboard friction member 120 pivots about the engagement point on the first rail 118 to allow the free or second end 126 to move a lateral distance corresponding to the high spot 212 and as a result lateral forces are not introduced into the anchor 112. As a high spot 212,212' on the rotor 26 continues to move toward the first rail 118, the high spot 212,212' will act on the second friction member 120' such that carrier 122' pivots about the first end 124 and as a result the second end 126 is free to laterally move and as a result the high spot 212 move between the entrance and exit engagement with the pads without the introduction of lateral forces into the anchor 112.

[0028] It should be understood that the description of the functional action of disc

brakes 10 and 110 are with a vehicle traveling in a forward direction but the features would equally apply when the vehicle is moving in reverse as the opposite ends of the carriers would then come into engagement the ~~appropiate~~ approiate support members such that pivoting could ~~occure~~ occur and allow a high point to past between the points of engagement. Disc brakes 10 and 110 equally perform in a same manner in reducing the introduction of lateral stress into an anchors 12 and 112 and as a result judding is essentially eliminated during a brake application.